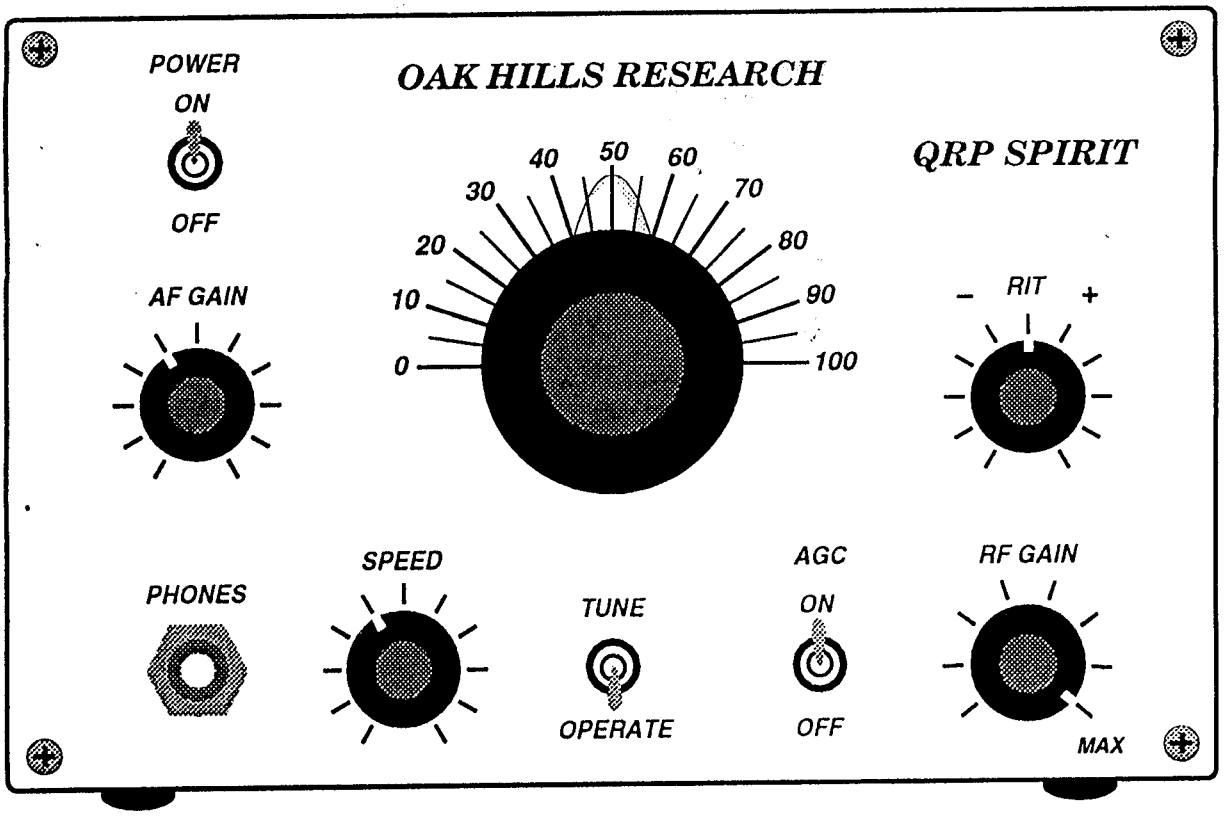
ASSEMBLY INSTRUCTIONS

QRP SPIRIT SP-1

20M



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INTRODUCTION

Thank you for purchasing the QRP Spirit SP-1 Transceiver kit. The SP-1 is a single band CW transceiver offered for the 80M, 40M, 30M, 20M and 15M band. It features a single conversion receiver through the use of a pre-mix VFO. The receiver features an RF pre-amp, diode ring mixer, high performance AGC circuit, audio filter after IF amp and 2 watts of audio output into 8 ohms. The transmitter has an RF output of 5W into 50 ohms. Other features include a Iambic Keyer using the latest Curtis Keyer Chip 8044ABM, a very smooth QSK circuit, a sinewave sidetone generator with frequency and level pots and a front panel mounted RF gain control. The transceiver covers 100 KHz of each band.

You will need the following tools and test equipment to assemble and align your kit: normal hand tools which include long-nose pliers; diagonal cutters; GOOD wire strippers; regular blade screwdriver (small & large); phillips screwdriver; pliers; .050" allen wrench; small hammer; 22 to 25 watt pencil soldering iron; alignment tool; ruler; frequency counter capable of reading 20 MHz; oscilloscope cabable of reading 20 MHz signals. A desoldering bulb and desoldering braid are also helpful to have.

Soldering is one of the most important operations you will perform while assembling your kit. About 95% of all kits returned to us for repair have problems caused by poor soldering. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly. It is easy to make good solder connections if you follow a few simple rules. Use the correct type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel tip works best. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned. ALWAYS use ROSIN CORE, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

A note on alignment. If you do not have the proper test equipment or do not wish to do the alignment yourself, Oak Hills Research will do the alignment and return the unit to you for a fee of $23.00. This fee is for alignment only on a properly assembled and working unit, it does not include the correction of assembly errors or other repairs. Payment must accompany unit.

The PC boards supplied in this kit are double-sided with plated-thru holes and component screen. The keyer board is single-sided and does not have plated-thru holes. We have included a blown-up diagram of the component screen of each board, and a schematic diagram. These will help locate component locations. When you assemble the PC boards, BE ABSOLUTELY SURE YOU HAVE THE CORRECT COMPONENT IN THE CORRECT LOCATION BEFORE SOLDERING IT IN PLACE! DOUBLE CHECK YOUR WORK BEFORE SOLDERING! With plated-thru holes, once you have soldered a component in place, and then want to remove it, it is much more difficult. If you do make a mistake and want to remove a component, follow this simple procedure: Use your desoldering bulb and your desoldering braid to remove ALL solder from the hole. Make sure the component leads are loose and free in the hole before removing the component.

ASSEMBLY

(1) Start the assembly of your kit by unpacking the components. Use the parts list and check off the parts. The Iambic keyer is packaged separately. Do not unpack this kit until told to do so. Just set this package aside.

(2) Locate the receiver PC board and position it with the component screen up. Refer to the blown-up board diagram and the parts list to locate components and their values.

(3) Start installing the resistors first, followed by the caps. Insert the component leads through the holes and then bend the leads slightly to hold them in place. Install four or five components at a time and then turn the board over and solder. Then trim the leads with your cutters. A few of the resistors mount vertically. Again, be sure you have the components in the correct holes before soldering. When installing the radial lead electrolytic capacitors, be sure to observe the correct polarity. The long lead is ALWAYS positive. Continue on until all resistors and caps are installed. Don't work too long at one time. Take frequent breaks.

(4) Install all the diodes. Be sure to observe the correct polarity and type. Match the banded end on the diode with the banded end on the board.

(5) Install the IC sockets. Match up the half moon end correctly. It is best to install the IC sockets one at a time. Be sure sockets are seated down on the board before soldering. Do not install the IC's at this time. Note: Do not install an IC socket at U5 on the 20M kit.

(6) Install the TO-39 size transistors. Slide a white spacer on the leads of the transistor and then install. Seat the transistor down against the board before soldering.

(7) Install the TO-92 type transistors and regulators. You will have to form the leads to fit the holes. Mount these devices about 1/4" above the board.

(8) Install all crystals. Y3,Y4,Y5,Y6 are a matched set. All crystals are mounted down against the board.

(9) Install the four shielded coils, L1,L3,L4,T13. Solder all leads on these coils. Note: L3 & L4 are not used in the 20M kit.

(10) Install pre-wound coils T1,T12. These coils can be installed either way.

(11) If you have not already done so, install all white trim pots. Note: Pot R3 is not used in the 20M kit.

(12) At this point, all components (except for wires & jumpers) should be mounted on the receiver board.

(13) Set the receiver board aside for now.

ASSEMBLY (cont)

(14) Locate the transmitter PC board and position it with the component side up.

(15) Following the same procedure used on the receiver board, mount the resistors, followed by the capacitors, etc.

(16) When you mount transistor Q9 (MRF476), bend the two outside leads down at 90 deg. Make this bend where the leads narrow. Bend the center lead down at 90 deg also, but start the bend at 1/8" from where the lead narrows. The three transistor leads must engage the three holes in the board and the large mounting hole on the tab must line up with the 1/8" hole in the board. When everything lines up correctly, place the large black heatsink between the board and the flat surface of the transistor. Place a 4-40 x 5/16" screw from the bottom of the board through the board, the heatsink and the transistor. Place a #4 lockwasher on the screw and secure with a 4-40 nut and tighten. Be careful not to allow the transistor to turn and bend the leads. Now solder the transistor leads.

(17) Slide a ribbed heatsink onto transistors Q11, Q12 and Q19 (on rec board). You may have to slightly pry open the heatsink to get it started.

(18) At this point, all components (except for wires & jumpers) should be mounted on the transmitter board. Set this board aside for now.

(19) Locate the lengths of 25 and 8 conductor cable. Using your cutters, cut the outer grey jacket back about 5 or 6" from one end. Start pulling the wires out of the cable one at a time. You will use these wires for all interconnections.

(20) In this step you will cut wires to a specified length and remove 1/4" of insulation from each end. You MUST use a GOOD QUALITY pair of wire strippers. DO NOT use a knife or diagonal cutters to remove the insulation. If you nick or cut into the strands of wire while removing the insulation, you will be constantly repairing broken wires on the boards and the connectors. When a wire color like BLUE/WHITE is called out, it means the wire is BLUE with a WHITE strip. Cut the following wires, then remove 1/4" of insulation from each end:

4 1/4" BLACK	4" ORANGE	5 1/2" ORANGE/BLACK
1 1/2" BLACK	4" ORANGE	4 1/2" ORANGE/GREEN
3" BLACK	18" YELLOW	13 3/4" GREEN/BLACK
5" BLACK	4 1/4" GREEN	10 1/2" GREEN/WHITE
4" BLACK	3" GREEN	4" BLUE/RED
2" BLACK	17 1/2" BLUE	4 1/2" BLUE/WHITE
3" BROWN	4" BLUE	6" WHITE/BLACK
5" RED	4 1/4" WHITE	2" WHITE/BLACK
4" RED	18" WHITE	13 1/2" RED/WHITE
7 1/2" RED	11 3/4" RED/BLACK	3" BLACK
3" RED	5 1/2" RED/GREEN	14 1/2" BLUE/BLACK
3" RED	9 3/4" RED/WHITE	2" BLACK

ASSEMBLY (cont)

(21) Position the receiver board in front of you. Locate the 2" length of #20 RED wire. This short length of wire is packed with other components. Cut a 1" length and remove 1/4" of insulation from each end. Install this wire at the location marked "TO C15". The other end will be connected later.

(22) Install the jumper wire located between C89 and C95. Use a component lead cutoff.

(23) Install the 2" WHITE/BLACK wire from JU1 to JU1. This jumper is located near U17.

(24) In this step you will install some of the prepared wires. We will call out the wire to install and indicate to the right where to install it. Free end will be connected later. NOTE: The hole labeled "R1 END" is not used.

4 1/4" BLACK - to "BLK" (near U3)
4 1/4" GREEN - to "GRN" (near U3)
4 1/4" WHITE - to "WHT" (near U3)
17 1/2" BLUE - to "BLU" (near U3)
5" RED - to "12V" (near R96)
13 3/4" GREEN/BLACK - to "R1 WIP" (near D26)
6" WHITE/BLACK - to "T" (near R133)
14 1/2" BLUE/BLACK - to "S2" (near R125)
4 1/2" BLUE/WHITE - to "R166 TOP" (near C142)
4 1/2" ORANGE/GREEN - to "R166 WIP" (near C142)

(25) Set the receiver board aside for now. Place the transmitter board in front of you. Using the same procedure, install the following wires.

5 1/2" RED/GREEN from JU3 to JU3
5 1/2" ORANGE/BLACK from JU4 to JU4
4" BLUE/RED from JU5 to JU5
4" ORANGE from JU6 to JU6
4" RED - to "TO 12V" (near C74)
7 1/2" RED - to "RED" (near large heatsink)
10 1/2" GREEN/WHITE - to "TO J2" (near C73)

(26) Cut a 1" piece of ORANGE wire and remove 1/4" of insulation from each end. Loop this wire through the center of T14 and install at "ONE TURN LOOP".

(27) Locate the long length of black miniature coax cable (RG174/u). Cut the following lengths: 3"; (3 1/2"; this cable for 20M kit only) 10 1/2"; 11"; 16 1/2"; and 24". Prepare these lengths of coax as follows: Carefully remove 1" of the black outer jacket. Be very careful not to cut into the shield braid. Now comb out the braid and separate from the inner conductor jacket. Twist the strands from the braid to form a lead. Now remove 1/4" of insulation from the inner conductor. Again, be careful not to cut into the wire strands. Apply a little solder to the twisted braid and inner conductor wire to tin them. Prepare the other end of this cable and both ends of the remaining cables.

ASSEMBLY (cont)

(28) Install the following prepared coax cables on the receiver board. Connect one end of the 24" cable to the hole pair location marked "TO J3 PHONES". The braid goes in the larger hole. Connect the 10 1/2" cable to the hole pair location marked "TX MIX". Connect the 11" cable to the hole pair marked "BPF". Label each cable near the free end with a piece of tape as follows: 24" cable - TO J3; 10 1/2" cable - TO VFO IN; 11" cable - TO REC MIX. The labeled free ends will be connected later. (FOR 20M KIT ONLY: Connect the 3 1/2" cable between the two places labeled "20M". One is near R11 and the other is near R35). Set the receiver board aside for now.

(29) Position the transmitter board in front of you. Connect one end of the 3" prepared coax cable to the hole pair marked "TO J1". The free end will be connected later. Install a bare wire jumper at the location labeled "JUMPER" just to the left of the large heatsink. Use a component lead cutoff. Set the transmitter board aside for now.

(30) Locate the Iambic Keyer kit which is packed separately. Unpack the kit and check the parts against the parts list. DO NOT remove the keyer IC from its package at this time. Using the same procedure used on the receiver and transmitter boards, start installing components on the board. As before, start with the resistors and then the caps. Continue on until all the components are installed. Use the Iambic "B" jumper position.

(31) Install the following prepared wires on the keyer board. The free ends will be connected later.

18" YELLOW - to "DASH"
18" WHITE - to "DOT"
3" RED - to "+12V"
3" BROWN - to "XMTR"
4" BLUE - to "R12" (near R10)
4" ORANGE - to "R12" (near R11)
3" GREEN - to "S1"

(32) Set the assembled keyer board aside for now.

CABINET ASSEMBLY

(1) Position the chassis in front of you with the large hole marked "B" to the right and the side flanges facing down. Refer to the sheet labeled "CHASSIS TOP VIEW. Place a #4 lockwasher on a 4-40 x 1/4" screw. From the bottom side of the chassis, insert this screw through hole "D". Install another #4 lockwasher on the screw and then a 3/8" threaded spacer. Tighten only finger tight. In a similar fashion, install a 3/8" threaded spacer at holes F, L, O and P.

(2) Position the receiver board over the spacers with the notched end to the left. Line up the holes in the board with the spacers. Start a 4-40 x 1/4" screw into each spacer. Now tighten each screw somewhat passed finger tight. Turn the chassis over and tighten all the screws securely. Turn the chassis over again and remove the screws holding the board. Remove the board and set it aside.

CABINET ASSEMBLY (cont)

(3) Install 3/8" spacers on the bottom of the chassis at holes A, C, E and N using the same procedure as before. Position the chassis with hole B at the top and the side flanges facing up. Position the transmitter board over the spacers with the heatsink outline to the right and line up the holes. Start all four 4-40 x 1/4" screws and then tighten somewhat passed finger tight. Turn the chassis over and tighten the other four screws securely. Turn the chassis over again and remove the transmitter board.

(4) Install four 3/8" spacers on the bottom of the chassis at holes I, J, K and M. Install these spacers using the same procedure as was used for the other two boards with the following exception: Do not install a #4 lockwasher between the spacer and chassis. After the spacers have been installed, position the chassis with hole B at the top and the side flanges up. Position the board over the spacers with the PC trim pot R2 to the left. As before, start four 4-40 x 1/4" screws in the spacers and tighten somewhat passed finger tight. Turn the chassis over and tighten the other four screws securely. Remove the keyer board. Install the 3/8" grommet in hole B.

(5) Locate the air variable capacitor, C15. Place a #4 lockwasher on two 4-40 x 5/16" screws. From the bottom of the chassis, insert these screws in holes G and H. Position capacitor C15 over the screws with the shaft extending out over the edge of the chassis. Start the screws into the machined holes on the bottom of the capacitor. Tighten securely.

(6) Locate the two side panels. These panels each have four 1/4" square holes punched in them. Position one of the panels with the end flanges facing down. Place on a small block of wood to support the panel. Insert one of the white nylon square nuts into one of the square holes. Use a small hammer to seat the nut in the hole while supporting it with the block of wood. Be careful not to bend the panel. Repeat on the other three holes. Use the same procedure on the second panel.

(7) Position one of the side panels so the end flanges face left and the two small holes are toward the top. Place a #4 lockwasher on a 4-40 x 5/16" screw. Position the chassis so the shaft of the air variable capacitor is facing away from you and the side flanges are facing up. Position the chassis and the side panel so the small holes line up. Insert the 4-40 x 5/16" screw through the side panel and the hole in the chassis flange. Install a #4 lockwasher and a 4-40 nut finger tight. Do the same with the other hole. Position the other side panel with the end flanges facing right. Secure with 4-40 hardware as above. Now tighten all four screws securely.

(8) Position the chassis/side panel assembly with air variable capacitor shaft facing you and the top of the chassis up. Line up the holes in the receiver board with the spacers. Install a 4-40 x 1/4" screw and a #4 lockwasher at each hole. After all five screws have been started, tighten securely. Be sure you haven't pinched any wires under the board.

(9) Route all three miniature coax cables through the chassis grommet at hole B. Route the following wires through the grommet: RED; GREEN/BLACK; BLUE; BLUE/BLACK; WHITE/BLACK.

CABINET ASSEMBLY (cont)

(10) Position the chassis so the bottom is facing up. Position the transmitter board over the spacers with the heatsink to the right. Install the free ends of the miniature coax cables coming from the grommet at the correct locations as indicated on the taped ends (VFO IN & REC MIX). Connect the free end of the WHITE/BLACK wire to any one of the three holes at the location marked "TO ALL T". Push the free ends of the two RED wires through the grommet. Position the transmitter board over the spacers and line up the holes. Be sure you don't have any wires pinched under the board. Secure the board with four 4-40 x 1/4" screws and four #4 lockwashers. Tighten securely. Dress the wires and cables toward the center of the board and tie with two or three plastic tie wraps. Leave the short coax cable to J1 loose.

(11) Remove the screw at hole G and install a 3 lug terminal strip at this location. Position the terminal strip so it is parallel with the side panels and the lugs are to the left of the mounting screw. Tighten securely. Label this terminal strip TB1 and the grounded lug #1, middle lug #2 and the end lug #3.

(12) Position the chassis so the receiver board is up and the rubber grommet is to the rear. Remove the screw at hole A and install a 2 lug terminal strip at this location. Position the terminal strip with the ground lug on the left. Tighten securely. Label this terminal strip TB2 and the grounded lug #1 and the right lug #2.

(13) Position the chassis so the transmitter board is up and the air variable shaft is facing you. Position the keyer board over the four remaining spacers with the weight pot, R2 to the left. Line up the holes and start four 4-40 x 1/4" screws. After all screws are started, tighten securely. Turn the chassis over and remove the screw at hole K. Install a #4 solder lug at this location. Remove the #4 lockwasher before reinstalling the screw. Position the solder lug so it is pointing toward the air variable cap. Tighten the screw securely. Set the chassis aside.

(14) In the following steps you will mount parts to the front and rear panels. Place a towel or soft cloth on your work table so as not to scratch or damage the painted surface of the panels.

(15) Locate the rear panel. From the inside of the panel, install a #6 solder lug with a 6-32 x 5/8 screw at the hole labeled GND. Position the solder lug to face toward the bottom of the panel. Secure with a #6 lockwasher and a large #6 nut. Tighten securely. Bend the solder lug 90 deg.

(16) Position the rear panel with the lettered side facing you and the hole labeled ANTENNA on the right. Install the SO-239 antenna jack J1 in this hole. The jack flange goes on the inside of the panel. At the lower left small hole, insert a 4-40 x 5/16" screw through the rear panel, and through the flange. Place a #4 solder lug on the screw and start a #4 nut. Position the solder lug up and tighten the nut. Bend the lug away from the flange. Insert 4-40 x 5/16" screws in the other three holes. Place a #4 nut and lockwasher on each screw and tighten securely.

(17) Install the coaxial power jack at the 12VDC hole. Position the jack so the ground tab faces left. Secure with the supplied hardware. Install the 1/8" square connector at the SPEAKER hole. Position this connector so the ground tab points upward. Use the supplied hardware.

CABINET ASSEMBLY (cont)

(18) Install the 1/4" dual key jack at the hole labeled KEY. Use the supplied hardware. Position the chassis with the receiver board up and the air variable cap shaft pointing away from you. Line up the four holes in the rear panel with the holes at the rear of the side panels. Insert a 6-32 x 3/8" Phillips head screw into one of the holes. Secure with a #6 lockwasher and a small #6 nut. Repeat at the other three holes.

(19) Locate the front panel and position it so the lettering is facing you and the POWER ON/OFF hole is at the upper left. Install SPDT toggle switches at POWER, TUNE and AGC. Use the supplied hardware. Remove the knurled nut and flat washer, leaving the hex nut on the threaded shaft. Secure with the flat washer and knurled nut. If you don't have the correct tool to tighten the special nut, you can use a small pair of pliers to tighten them. Be careful not damage the panel with the pliers.

(20) With the front panel in the same position as in the previous step, install the larger 10K ohm pot at the AF GAIN hole. Break off the small location tab. Use the supplied hardware and position the pot so the terminals are facing up.

(21) Install the large 500K ohm pot at the SPEED hole. Break off the small location tab. Use the supplied hardware and position the pot so the terminals are to the right.

(22) Install the center detent pot at the RIT hole. Break off the small location tab. Use the supplied hardware and position the pot so the terminals are facing up.

(23) Install the small 10K ohm pot at the RF GAIN hole. Bend the small location tab straight out. Use the supplied hardware. Position the pot so the terminals are facing to the left.

(24) Install the 1/4" phone jack at the PHONES hole. Use the supplied hardware and position the jack so the long contact bar is down. This jack must be positioned this way in order to clear the top of the keyer board.

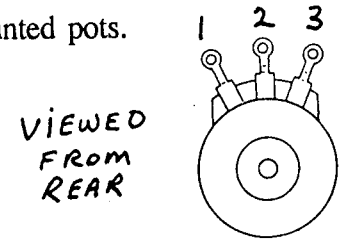
(25) Line up the four holes in the front panel with the holes in the flanges. Insert a 6-32 x 3/8" Phillips head screw through one of the holes in the front panel and through the flange hole. Secure with a #6 lockwasher and small #6 nut. Repeat at the other three holes.

FINAL WIRING

(1) Position the chassis with the receiver board up and the front panel facing you. Connect the free end of the #20 RED wire to the right rear terminal of air variable capacitor, C15. Just put a gentle arc in this wire and point the end at the terminal. Push the wire end into the terminal just far enough to be able to make a good solder connection. Be careful not to short the wire to the chassis.

FINAL WIRING (cont)

(2) Use the following diagram to identify the terminals on the panel mounted pots.



(3) Position the radio with the receiver board up and the rear panel facing you. Connect the free end of the GREEN wire to terminal #1 of R20, the RIT pot. Connect the WHITE wire to terminal #2, and the BLACK wire to terminal #3. Dress the wires down and against the side panel.

(4) Connect the 1 1/2" BLACK wire that you prepared previously to terminal #1 of R166, the AF GAIN pot. Connect the other end to the near-by solder lug. Connect the ORANGE/GREEN wire to terminal #2 and the BLUE/WHITE wire to terminal #3. Dress the wires down and against the side panel.

(5) Connect one end of the 11 3/4" RED/BLACK wire prepared previously to the bottom terminal of switch S1 (POWER switch). Route this wire down on top of the chassis and against the side panel to the center pin of J5, the coaxial power connector (12VDC). Do not solder this connection yet. Insert the male plug into the coaxial power jack. This will hold the center pin in alignment while you solder the connection. Solder this connection.

(6) Connect one end of the previously prepared 9 3/4" RED/WHITE wire to the center terminal of switch S1. Route this wire along the chassis as above to TB2, lug #2. Do not solder this connection yet as more wires have to be connected. Connect the RED wire from the receiver board to TB2, lug #2. Again, do not solder yet.

(7) Connect the two RED wires coming from the grommet to TB2, lug #2. Connect one end of the previously prepared 13 1/2" RED/WHITE wire to lug #2. You should have five wires connected to lug #2. Solder all five securely. Route the free end of the RED/WHITE wire through the grommet.

(8) Position the radio with the receiver board up and the front panel facing you. If necessary, loosen the hex mounting nut on the rear panel holding the KEY jack. Position the KEY jack so the center terminal is straight up. Retighten the mounting nut. Connect the YELLOW wire coming from the grommet to the right terminal of the KEY jack. Connect the WHITE wire to the left terminal.

FINAL WIRING (cont)

(9) With the radio positioned the same as in the previous step, solder one end of the previously prepared 4" BLACK wire to the center terminal of the KEY jack. Connect the other end to the ground tab on the 12VDC coaxial connector. Don't solder this connection yet.

(10) Locate the prepared 16 1/2" length of miniature coax cable. At one end solder the center conductor to the lower terminal of the SPEAKER jack on the rear panel. Solder the braid to the top terminal. Route the free end of this cable through the grommet. Turn the radio over and route the speaker cable along the right edge of the chassis to the front panel PHONE jack. Temporarily remove the four mounting screws from the keyer board and set the board aside. Turn the chassis so the rear panel is facing you. Solder the inner conductor of this speaker cable to the center terminal of the PHONE jack. Route the free end of the cable labeled "TO J3" along the same path as the speaker cable. Solder the inner conductor to the left terminal of J3. Solder the braids from both cables to the right terminal. Dress both cables between J3 and the chassis so as not to short on the underside of the keyer board. Carefully remount the keyer board.

(11) Connect the free end of the 13 1/2" RED/WHITE wire to terminal #3 of TB1. Don't solder yet. Connect the BLUE wire to terminal #2 of TB1. Don't solder yet. Connect the GREEN/WHITE wire to terminal #2 of TB1. Don't solder yet. Connect the BROWN wire from the keyer board to terminal #2 of TB1. Solder this connection. There should be three wires on terminal #2. Connect one end of the prepared 3" RED wire to terminal #3 of TB1. Don't solder yet. Connect the RED coming from the keyer board to terminal #3 of TB1. Solder this connection. There should be three wires on terminal #3. Solder the free end of the 3" RED wire to terminal #1 of the RF GAIN pot, R1.

(12) Solder the free end of the GREEN/BLACK wire to terminal #2 of R1. Solder one end of the prepared 3" BLACK wire to terminal #3 of R1. Connect, but do not solder the other end to terminal #1 of TB1. Solder the free end of the BLUE/BLACK wire to the center terminal of the AGC switch. Connect one end of the prepared 2" BLACK wire to terminal #1 of TB1. Don't solder this connection yet. Solder the other end to the lower terminal (closest to the chassis) of the AGC switch. Solder one end of the prepared 2" BLACK wire to the center terminal of the TUNE switch. Solder the other end to terminal #1 of TB1. There should be three wires soldered to this terminal.

(13) Solder the free end of the GREEN wire coming from the keyer board to the top terminal of S1 (farthest from the chassis). Remove another 1/4" of insulation from the free end of the ORANGE wire coming from the keyer board. Solder this wire to terminals 2 and 3 of the SPEED pot. Solder the remaining BLUE wire to terminal #1 of the SPEED pot. Dress these wires so they don't interfere with the phone jack.

FINAL WIRING (cont)

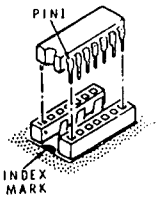
(14) Turn the radio so the front panel is facing you (transmitter board facing up). Solder the center conductor of the short length of coax to the center pin of the ANTENNA jack. Connect the braid to the solder lug (don't solder yet). Cut the remaining prepared 8" BLACK wire into three 2 1/2" lengths. Prepare all three lengths. Solder one end of a 2 1/2" BLACK wire just prepared to the solder lug on the antenna jack. There should be two wires solder to this lug. Connect the other end to the solder lug on the 6-32 x 5/8" screw. Solder the free end of the other prepared 2 1/2" BLACK wire to this solder lug. There should be two wires soldered to this lug. Route the free end of the BLACK wire through the grommet. Turn the radio over and connect the BLACK wire to the ground tab on the coaxial power jack. Solder one end of the remaining BLACK wire to the coaxial power jack ground tab. Solder the other end to lug #1 of TB2.

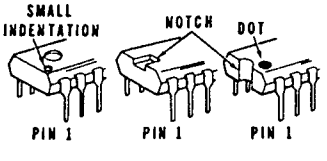
(15) Solder a 1N4007 diode across the terminals of the coaxial power jack. Solder the banded end to the center pin and the other end to the ground tab. This completes the wiring. All connections should be soldered at this time. Look the radio over and be sure this is the case. Also, dress all wiring as neat as possible and tie with the supplied plastic ties.

(16) Position the brass dial mounting hub on your work table with the small collar facing up. Using two 2-56 x 1/4" screws, mount the plastic dial pointer on the hub. The RED line should be toward the table. Tighten the screws just enough to hold the dial in place. Turn the shaft of the air variable capacitor C15 fully counterclockwise. Slide the mounting hub assembly onto the shaft with the large collar toward the capacitor. Turn the hub assembly until the RED cursor line is lined up with the "0". Tighten the Allen head set screw. Be sure the dial pointer does not rub on the front panel. Adjust as needed. If the brass mounting hub rubs or binds in the large hole on the front panel, you may have to loosen the four front panel mounting screws to make minor adjustments. Slide the large black knob onto the shaft and tighten the set screw. Again, be sure there is no binding.

(17) Turn the AF GAIN pot shaft fully counterclockwise. Install a small knob by lining up the white dot & notch with the lower left tick mark. Tighten the set screw. You may have to adjust the knob in or out on the shaft to prevent the back of the knob from binding on the mounting nut. Install a small knob on the RIT control. Set the RIT control to the center detent position. Align the white dot & notch to the center mark. Turn the shafts of the SPEED and RF GAIN pots to the fully clockwise position. Install small black knobs at these locations. Note that these two knobs have the white dot & notch lined up with the lower right mark.

(18) Refer to the board component screen sheets and the parts list. You will now install the IC's on all three boards. Before you install an IC into a socket, place the IC on a wood surface with the pins flat against the wood and roll it until the pins are 90 deg to the body. In other words, so the pins are straight up & down. This makes it a lot easier to insert the IC into the socket without bending the pins under. Also, be sure to position the IC correctly. See diagram below. When you install the keyer IC 8044ABM, BE CAREFUL WHEN HANDLING THIS IC. BE ABSOLUTELY SURE YOU ARE WELL GROUNDED BEFORE EVEN TOUCHING THIS IC AND DURING THE TIME YOU ARE INSTALLING IT!!!!! This IC can be destroyed by static charges while it is out of the circuit. Install all IC's. This completes the assembly and wiring of the QRP Spirit. The alignment will be performed next.





ALIGNMENT (20M)

(1) Position the radio with the front panel facing you and the receiver board up. Attach a suitable 50 ohm dummy load to the antenna jack. Adjust R27 to the center of it's range. Attach your frequency counter to the forward lead (lead closest to the front panel) of capacitor C20. Capacitor C20 is just to the left of mixer U17. Attach a 13.6 VDC power supply to the coaxial power jack and apply power. Be sure you have the positive power supply line going to the center pin of the coaxial power jack. This positive power supply line should have a 2A fast blow fuse in line. Turn the radio power switch to the on position. Set the main tuning knob to "0" and the RIT pot to it's center detent position. The TUNE/OPERATE switch should be in the operate position. The AGC switch should be in the on position.

(2) Adjust coil L1 for a frequency of 5.0 MHz. Set the main tuning dial to "100" and adjust C14 for a frequency of 5.1 MHz. Set the main tuning dial to "0" and again adjust L1 for a frequency of 5.0 MHz. Set the dial to "100" and adjust C14 for a frequency of 5.1 MHz. As you can see, these two adjustments interact with each other. Continue the above adjustment procedure until you have exactly 100 KHz of coverage. Each adjustment brings you a little closer to this range. These adjustments provide coverage from 14.0 to 14.1 MHz.

(3) Set the main tuning to any position and record the frequency. Place the TUNE/OPERATE switch in the tune position and observe the frequency on the counter. Adjust R27 until the frequency is the same as the recorded frequency. Don't leave the switch in the tune position for more than a few seconds at a time. You may have to repeat this adjustment several times to get the two frequencies to match. Turn the radio off. Remove the frequency counter and the dummy load.

(4) Turn the radio over. Set the main tuning pointer to "50" and R63 to mid range. Attach an accurate QRP wattmeter capable of reading 5W to the antenna jack. Terminate the wattmeter with a 50 ohm dummy load. Turn the radio on. Set the TUNE/OPERATE switch to tune and adjust coils L14 and L15 (located on the transmitter board) for maximum power out. Don't leave the tune switch in the tune position for more than a few seconds at a time. If you could not get 5W out, or you had more than 5W out, adjust R63 and repeat. Check the power output while turning the main tuning knob from "0" to "100" on the dial. You should have 5W out across the entire range with very little variation. If you do not have this, continue adjusting L14 and L15 and R63.

ALIGNMENT (20M) cont

(5) Turn the radio over so the receiver board is up. Attach a 50 ohm, 20M antenna to the antenna jack. Turn the radio on and attach headphones to the phones jack or an 8 ohm speaker to the speaker jack on the rear panel. Tune in a CW signal near the center of the dial. Adjust C109 for a 700 or 800 Hz CW note. You may have to make minor adjustments to the main tuning dial while adjusting C109. As you adjust C109, the CW signal will get louder as you center the signal in the audio filter. You will find a setting where the CW note is loudest and is at the correct frequency. Check to verify that C109 was adjusted on the lower sideband of the crystal filter. This is very easy to check. Tune in a CW signal. As you slowly turn the main tuning dial toward "0", the CW signal should get lower and lower in frequency until you reach zero beat. If the signal goes higher and higher in frequency, this means you have C109 adjusted on the wrong side of the crystal filter, on the upper sideband. If this is the case, simply repeat the above adjustments. Generally, the CW audio signal will be louder when the BFO is set to the correct sideband (lower sideband). Once you have the above BFO adjustments made correctly, tune in a CW signal and adjust T13 for maximum signal.

(6) Turn the radio over so the transmitter board is up. In this adjustment you will adjust the transmitter carrier oscillator. Attach a 50 ohm dummy load to the antenna jack. Turn the radio on and set the main tuning to "50". If you have another transceiver or have access to one, it will be very helpful for this adjustment. Terminate your other transceiver in it's own 50 ohm dummy load. Now transmit with the other radio into it's dummy load and find the signal on the QRP Spirit. Tune the Spirit for the loudest signal. Be sure the RF GAIN is set to MAX and the AGC is on. Also, the RIT control should be set to the center detent. Now, without touching the main tuning on either radio, place the TUNE/OPERATE switch in the tune position. While listening for the QRP signal in the other radio, adjust C56 on the transmitter board, until you hear a nice mellow tone in the other radio. Don't leave the tune switch on for more than a few seconds at a time.

(7) Adjust R168 on the receiver board for the sidetone frequency you prefer. Adjust R146 for a comfortable sidetone level. Also, adjust the keyer weight trim pot on the keyer board to mid range or to a setting of your choice.

(8) Attach the top and bottom covers using the #8 x 1/2" black self-tapping screws. Install the four rubber feet on the bottom cover. Position the feet 1/2" in from each edge.

(9) YOU'RE FINISHED!!!

OPERATION

The operation of the QRP Spirit is straightforward and easy. Simply attach a power supply capable of delivering 13.6 VDC @ 1.5A, a 50 ohm antenna, your favorite iambic key and a pair of headphones or a speaker. With a good antenna, stations worldwide can be routinely worked.

Use a well regulated power supply. DO NOT use a plug in the wall type power supply. Most of these units have little or no regulation.

The RIT control will vary the receive frequency ± 800 Hz. The RIT is defeated on transmit. Leave it in the center detent position when not being used.

The RF GAIN control can be used with the agc on or off.

The TUNE/OPERATE switch is used to manually turn the transmitter on to make antenna tuner adjustments.

The keyer SPEED control adjusts the CW code speed on transmit. The speed is minimum with the knob clockwise and maximum with the knob counterclockwise. The speed pot is an audio taper type and is wired this way to make the speed adjustments more linear.

We hope you have enjoyed building the QRP Spirit, and that it provides you with many years of trouble free service. As always, we appreciate any comments or suggestions you may have.

OAK HILLS RESEARCH

PARTS LIST (SP-1)

C1,C5,C16,C18,C19,C23,C28,C37,C38,C39,C40,C41,C42,C43,C45,C46,C55,C57,C62,C64,C70, C71,C79,C82,C90,C96,C99,C101,C104,C112,C113,C118,C133,C140,C141 -.1uF Mono Cap (104)

C2,C6 - 680pF NP0 Mono Cap (681)

C3,C4,C12,C13,C20,C21,C22,C24,C26,C29,C33,C48,C52,C53,C54,C59,C61,C65,C73,C75,C76, C77,C78,C80,C83,C98,C102,C103,C107,C108,C143 - .01uF Mono Cap (103)

C7,C8,C10,C35 - 47pF NP0 Mono Cap (470)

C9 - 220pF NP0 Mono Cap (221)

C11,C25 - 100pF NP0 Mono Cap (101)

C14 - 9-60pF Trim Cap (BRN)

C15 - 4-17pF Air Variable Cap (MAIN TUNING)

C30,C47,C63,C106 - 68pF NP0 Mono Cap (680)

C34 - 82pF NP0 Mono Cap (820)

C36,C74,C95,C125,C135 - 10uF Electrolytic Cap

C44,C105 - 33pF NP0 Mono Cap (330)

C56 - 5-30pF Trim Cap (GRN)

C69 - 10pF NP0 Mono Cap (100)

C72 - 56pF NP0 Mono Cap (560)

C81,C119 - 100uF Electrolytic Cap

C84,C110,C115,C117 - 22uF Electrolytic Cap

C85,C100,C131 - .001uF Mono Cap (102)

C87,C94 - 330pF NP0 Mono Cap (331)

C88 - 18pF NP0 Mono Cap (180)

C89,C121 - 51pF NP0 Ceramic Disc Cap (51)

C91,C93 - 470pF NP0 Mono Cap (471)

PARTS LIST (SP-1) cont

C92 - 560pF NP0 Mono Cap (561)

C97,C128 - 1uF Electrolytic Cap

C109 - 6-50pF Trim Cap (ORG)

C111 - 1uF Mono Cap (105)

C114 - 2.2uF Electrolytic Cap

C116 - 47uF Electrolytic Cap

C120,C122,C127 - .022uF Polyester Cap (223)

C123,C124,C126 - .01uF Polyester Cap (103) GREEN

C129,C130,C134 - .0022uF Polyester Cap (222)

C132,C139,C142 - 4.7uF Electrolytic Cap

C136,C138 - 220uF Electrolytic Cap

C137 - .0033uF Polyester Cap (332)

D2,D5,D6,D17,D18,D19,D20,D21,D22,D23,D25,D26 - Silicon Diode (1N4148)

D3 - Varactor Diode (MV2109)

D4,D7,D16,D24 - 9.1V Zener Diode (1N5239B)

D8,D9,D10,D11,D14,D15 - Silicon Diode (1N4152)

D12,D13,D28 - Silicon Diode (1N4007)

D27 - 33V Zener Diode (1N4752)

J1 - SO-239 Connector (ANT)

J3 - 1/4" Phone Jack (PHONES)

J4 - 1/8" Phone Jack (SPEAKER)

J5 - Coaxial Power Jack (12V)

L1 - 8uH Variable Inductor (STYLE 3)

PARTS LIST (SP-1) cont

L2,L5,L6,L8,L9,L11,L12,L13,L16,L20,L21,L23,L24,RFC1 - 100uH Choke (BRN-BLK-BRN)

L7,L10,L17,L22 - 22uH Choke (RED-RED-BLK)

Q1 - J310 N Channel J-FET Transistor

Q2,Q3,Q15,Q17 - 2N3904 NPN Transistor

Q4,Q14,Q18 - 2N3906 PNP Transistor

Q5,Q6,Q10,Q13,Q22,Q23,Q25 - 2N4401 NPN Transistor

Q7,Q8,Q20 - MPF102 N Channel J-FET Transistor

Q9 - MRF476 NPN Transistor

Q16,Q24 - 2N3053 NPN Transistor

Q11,Q12,Q19,Q21 - 2N3866 NPN Transistor

R1 - 10K Ohm Linear Taper Panel Mount (B10K)

R2,R24,R32,R45,R48,R120,R145 - 47 Ohm 1/4W Res (YEL-VIO-BLK)

R3,R63 - 1K Ohm PC Mount Trim Pot (102)

R4,R17,R35,R38,R50,R66,R79,R88,R90,R92,R99,R122,R126,R128,R155,R167 - 1K Ohm 1/4W Res (BRN-BLK-RED)

R5,R57,R89,R111,R172 - 2.2K Ohm 1/4W Res (RED-RED-RED)

R6,R15,R37,R58,R115,R118,R130,R164 - 100K Ohm 1/4W Res (BRN-BLK-YEL)

R7,R8,R21,R33,R80,R85,R86,R93,R94,R129,R132,R133,R134,R136,R137,R157, R163, R165,R171 - 10K Ohm 1/4W Res (BRN-BLK-ORG)

R9,R16,R19,R22,R30,R31,R34,R47,R51,R72,R77,R81,R82,R96,R98,R121,R139 - 100 Ohm 1/4W Res (BRN-BLK-BRN)

R10,R101,R109,R140,R147 - 22K Ohm 1/4W Res (RED-RED-ORG)

R11 - 68 Ohm 1/4W Res (BLU-GRY-BLK)

R12,R26,R144 - 220 Ohm 1/4W Res (RED-RED-BRN)

PARTS LIST (SP-1) cont

R13,R23,R29,R53,R60,R73,R74,R75,R87,R104 - 470 Ohm 1/4W Res (YEL-VIO-BRN)

R14 - 1M Ohm 1/4W Res (BRN-BLK-GRN)

R18,R25,R54,R55,R67,R69,R107 - 1.5K Ohm 1/4W Res (BRN-GRN-RED)

R20 - 10K Ohm Panel Mount Pot (Center Detent) RIT

R27 - 20K Ohm PC Mount Trim Pot (203)

R28,R43 - 12K Ohm 1/4W Res (BRN-RED-ORG)

R36,R151,R160,R162 - 15K Ohm 1/4W Res (BRN-GRN-ORG)

R39,R83,R127,R161 - 680 Ohm 1/4W Res (BLU-GRY-BRN)

R40,R100,R124 - 3.3K Ohm 1/4W Res (ORG-ORG-RED)

R41,R64,R106 - 270 Ohm 1/4W Res (RED-VIO-BRN)

R42,R44,R108 - 560 Ohm 1/4W Res (GRN-BLU-BRN)

R46,R68,R114 - 330 Ohm 1/4W Res (ORG-ORG-BRN)

R52,R71,R91,R95 - 1 Ohm 1/4W Res (BRN-BLK-GLD)

R56,R135 - 4.7K Ohm 1/4W Res (YEL-VIO-RED)

R59,R116 - 820 Ohm 1/4W Res (GRY-RED-BRN)

R61 - 510 Ohm 1/4W Res (GRN-BRN-BRN)

R62 - 240 Ohm 1/4W Res (RED-YEL-BRN)

R65,R78 - 39 Ohm 1/4W Res (ORG-WHT-BLK)

R70 - 10 Ohm 1/4W Res (BRN-BLK-BLK)

R76,R152,R169 - 4.7 Ohm 1/4W Res (YEL-VIO-GLD)

R84,R141,R142 - 47K Ohm 1/4W Res (YEL-VIO-ORG)

R97,R105 - 56 Ohm 1/4W Res (GRN-BLU-BLK)

PARTS LIST (SP-1) cont

R102,R103 - 33 Ohm 1/4W Res (ORG-ORG-BLK)

R110 - 5.6 Ohm 1/4W Res (GRN-BLU-GLD)

R112 - 27K Ohm 1/4W Res (RED-VIO-ORG)

R113 - 220K Ohm 1/4W Res (RED-RED-YEL)

R117,R119 - 150 Ohm 1/4W Res (BRN-GRN-BRN)

R123 - 430 Ohm 1/4W Res (YEL-ORG-BRN)

R125 - 560K Ohm 1/4W Res (GRN-BLU-YEL)

R131 - 75K Ohm 1/4W Res (VIO-GRN-ORG)

R138 - 7.5K Ohm 1/4W Res (VIO-GRN-RED)

R143,R170 - 6.8K Ohm 1/4W Res (BLU-GRY-RED)

R146,R168 - 10K Ohm PC Trim Pot (103)

R148,R149,R150,R153,R154,R156,R158,R159 - 33K Ohm 1/4W Res (ORG-ORG-ORG)

R166 - 10K Ohm Audio Taper Panel Pot (A10K)

S1,S2 - SPDT Toggle Switch

T1,T7,T8,T12,T14 - Pre-wound Bifilar Transformer

T13 - IF Transformer (42IF123) GRN CORE

U1,U3 - 9V Reg (78L09)

U5,U9 - MC1496P IC

U17 - TUF-1 Mini-Circuits Mixer

U18 - MC1350P IC

U19 - NE602AN IC

U20,U30 - LM301AN IC

U24 - LM324 IC

U31,U32 - TL072CP IC

U33 - LM380 IC

PARTS LIST (SP-1) cont

Y2, Y3, Y4, Y5, Y6, Y7 - 9MHz Crystal (Y3, Y4, Y5, Y6 are matched)

1) 10-101 - Cabinet

1) 40-0101 - PC Board (Rec)

1) 40-0102 - PC Board (Trans)

1) TO-220 type Heatsink

3) TO-39 Press-on type Heatsink (RED)

6) 8 pin dip IC socket

4) 14 pin dip IC socket

4) Small knob

1) Large knob

1) Dial mounting hub

1) Dial Pointer

1) Wire pack

1) Hardware pack

1) Band pack

1) Keyer kit

1) Instruction set

BAND PACK PARTS LIST (20M)

C49,C51 - 100pF NP0 Mono Cap (101)

C50 - 4.7pF NP0 Mono Cap (479)

C58,C60 - 560pF NP0 Mono Cap (561)

C66,C68 - 120pF Ceramic Disc Cap (121)

C67 - 270pF Ceramic Disc Cap (271)

L14,L15 - 1.0uH Adj Inductor (T1050)

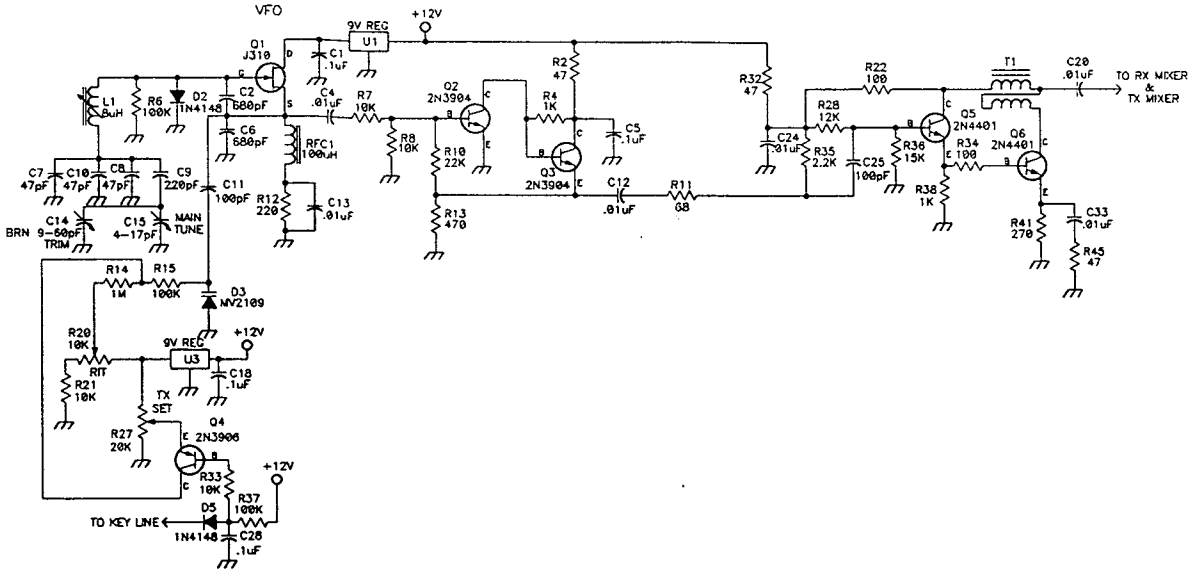
L18,L19 - Pre-wound Toroid Coil

20M KIT

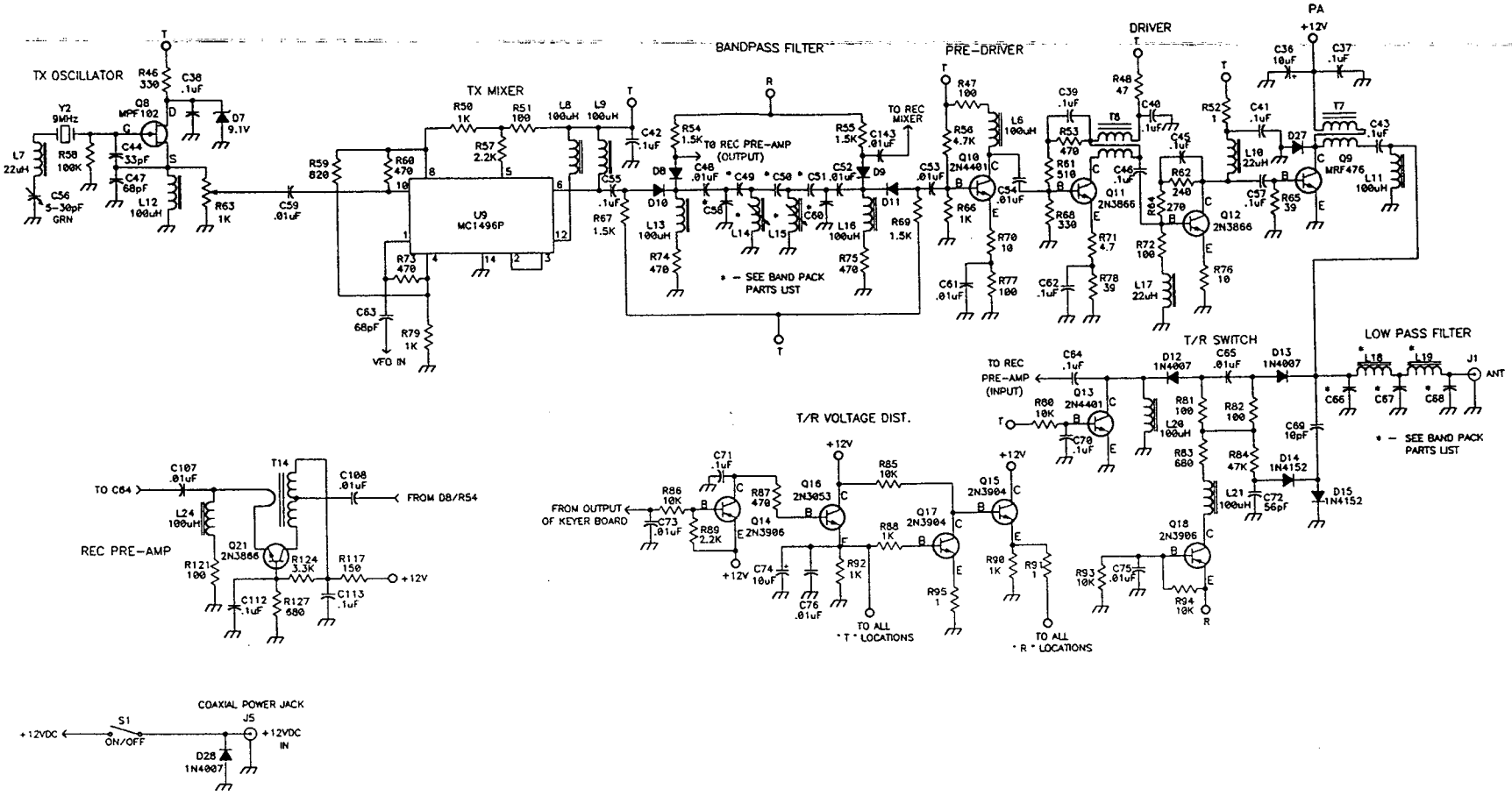
The QRP Spirit series of kits uses a pre-mix vfo with a 9 MHz IF frequency on 80M, 40M, 30M and 15M. The vfo operates at 5 MHz and is mixed with a hetrodyne (pre-mix) oscillator to generate the LO signal that is applied to the receiver and tranmitter mixers. On 20M the 5 MHz vfo signal is fed directly into the mixers without the need to pre-mix. Therefore, on 20 meters the components for the pre-mix oscillator and mixer are not used. Listed below are the components not to be used when building the 20 meter kit. You can put these components in your surplus box for use on other projects.

Delete from parts list of 20M kit:

C3, C16, C19, C21, C22, C23, C26, C27, C29, C30, C31, C32, C34, C35, D4, D6, L2, L3, L4, L5, R3, R5, R9, R16, R17, R18, R19, R23, R24, R25, R26, R29, R30, R31, R39, R40, R42, R43, R44, R49, Q7, U5 AND Y1



Title	OAK HILLS RESEARCH		
Size C	Number	QRP SPIRIT SP-1 20M VFO	Rev A
Date	7/18/92	Drawn by	DW
Filename		Sheet 1 of 3	



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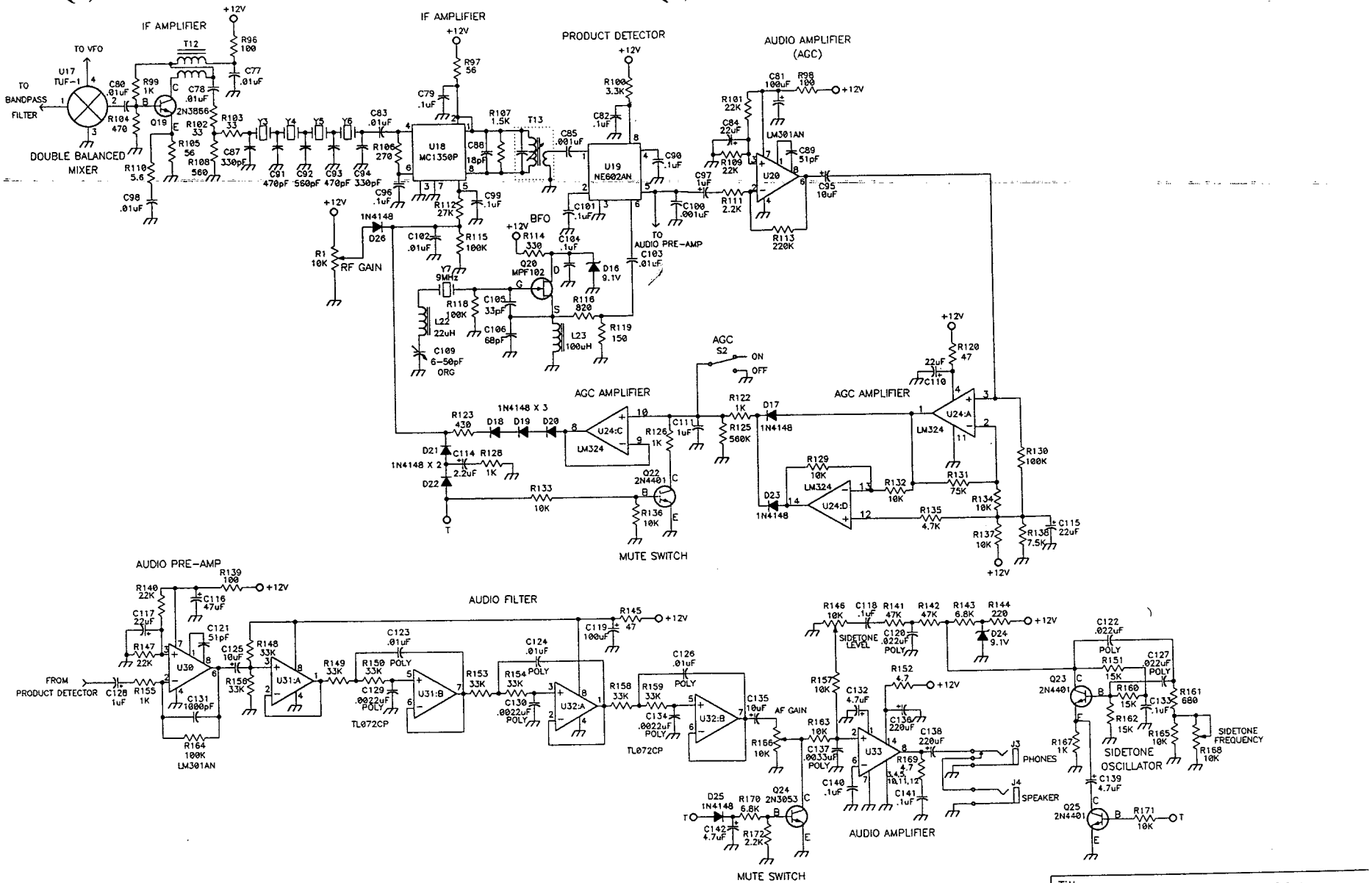
Filename	SPIRIT.S02	Sheet 2 of 3	



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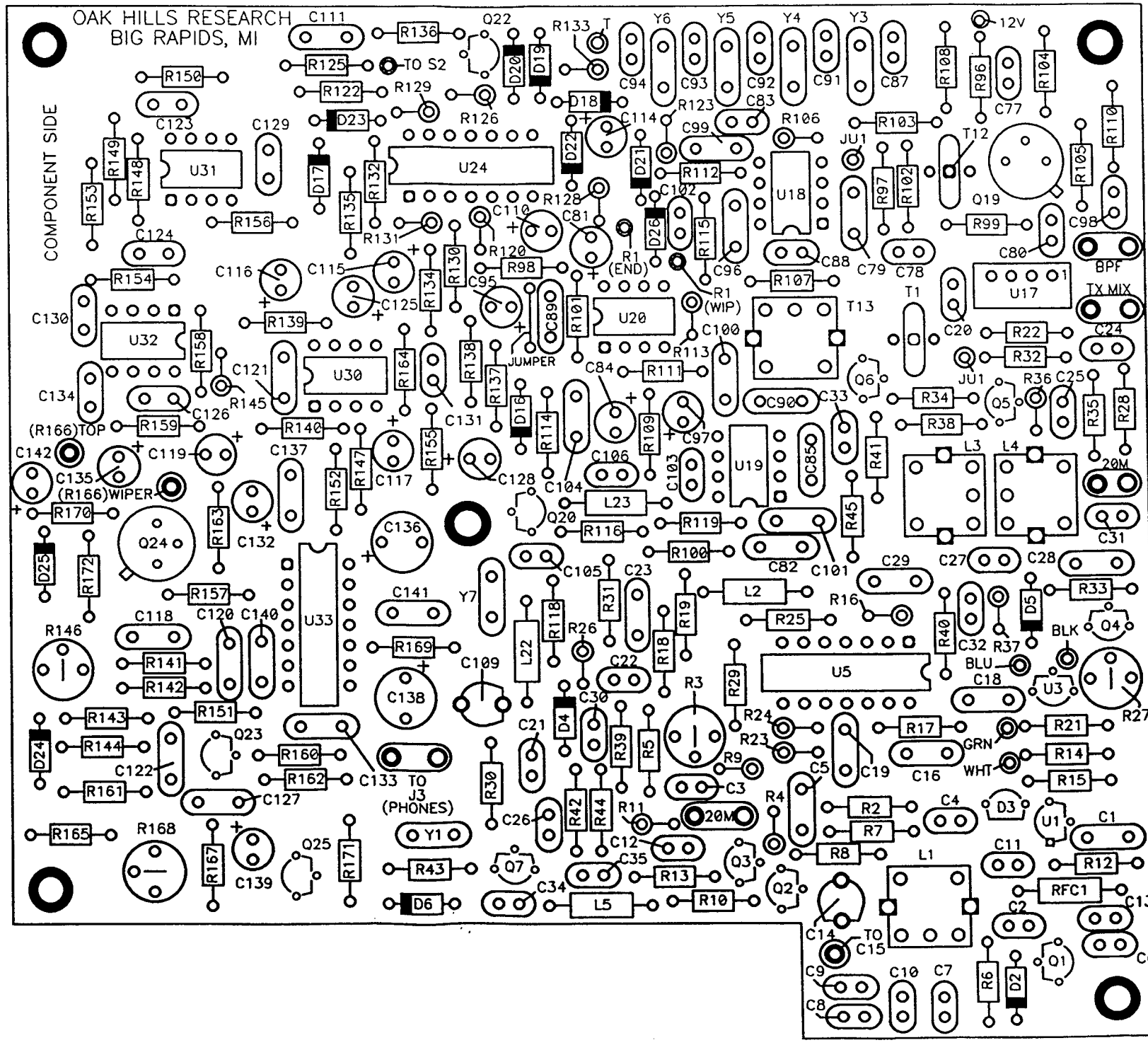
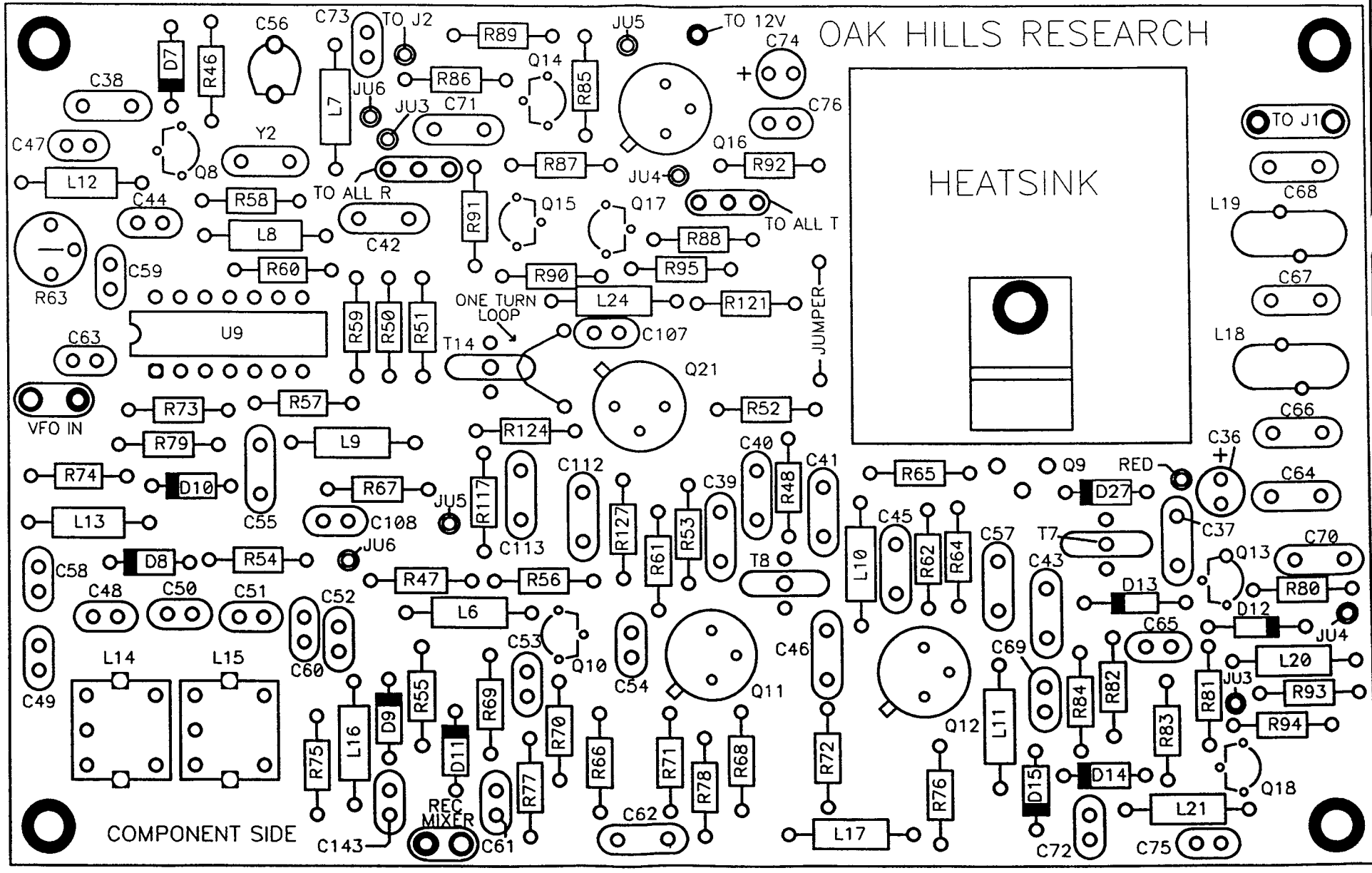
Date	7/18/92	Drawn by	DW
Filename	SPIRIT.S03	Sheet	3 of 3


OAK HILLS RESEARCH
BIG RAPIDS, MI
COMPONENT SIDE
TO S2
(R166)TOP
(R166)WIPER
TO J3 (PHONES)
JUMPER
R1 (END)
R1 (WIP)
TO
12V
BPF
TX MIX
20M
BLK
BLU
GRN
WHT
U31
U24
U32
U30
U33
U20
U18
U19
U17
U5
T13
L1
L2
L3
L4
L5
L22
L23
RFC1
Y1
Y7
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q19
Q20
Q23
Q24
Q25
JU1


OAK HILLS RESEARCH
HEATSINK
COMPONENT SIDE
TO J1
TO J2
TO 12V
TO ALL R
TO ALL T
VFO IN
REC MIXER
ONE TURN LOOP
JUMPER
RED
C38
C47
C44
C59
C63
C58
C48
C50
C51
C49
C56
C73
C71
C42
C60
C52
C143
C61
C62
C54
C53
C46
C69
C72
C75
C74
C76
C68
C67
C66
C64
C36
C37
C70
C65
C43
C57
C45
C39
C40
C41
C112
C113
C108
C107
C55
C124
C121
C90
C95
C88
C92
C87
C85
C91
C117
C127
C61
C48
C53
C10
C11
C12
C72
C75
L12
L8
L9
L13
L14
L15
L16
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L10
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L18
L20
L21
R63
R60
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R50
R51
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R124
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R62
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R68
R72
R76
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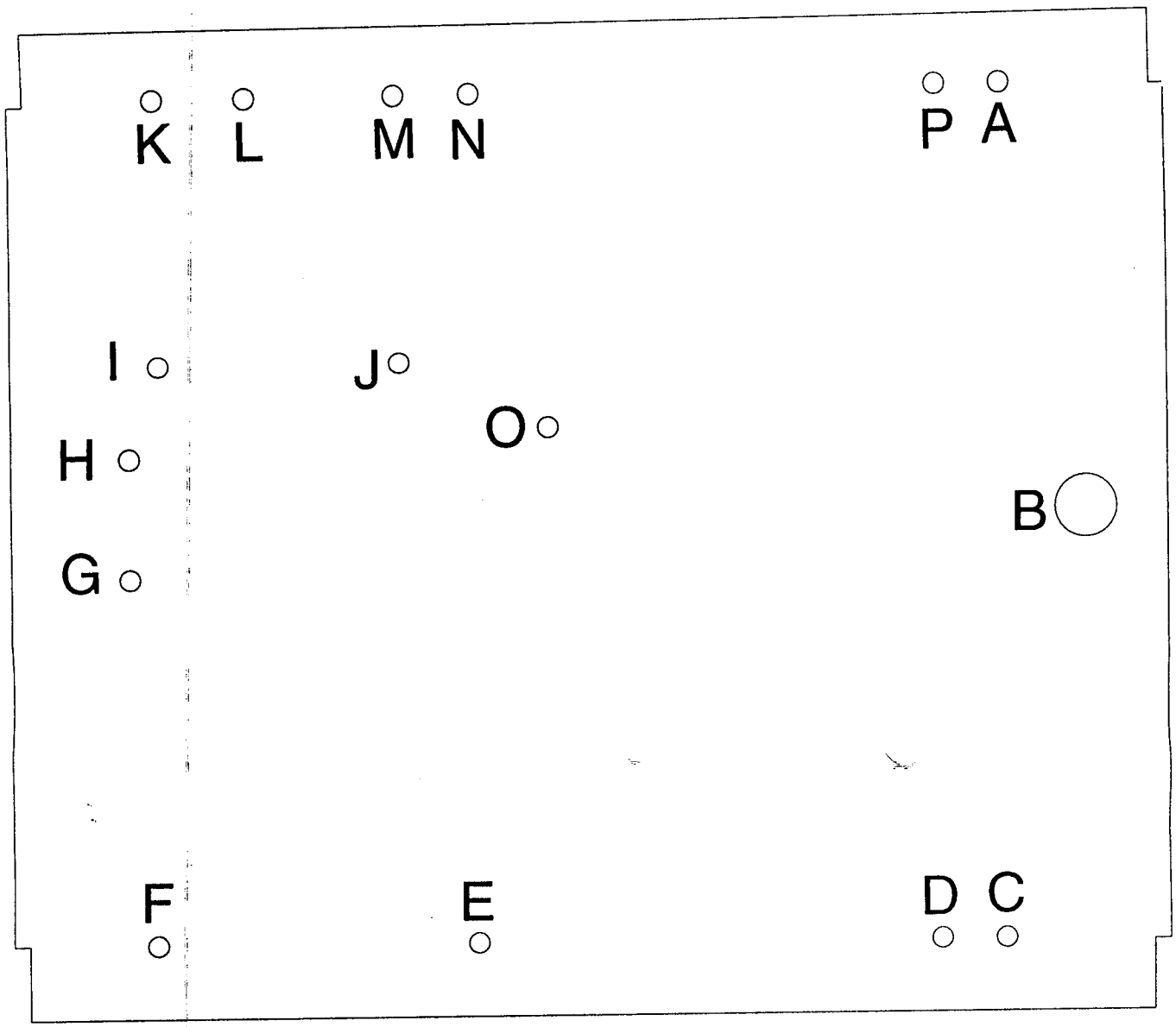
R55
R77
R84
R82
R83
R81
R93
R94
R80
U9
Y2
Q8
Q14
Q15
Q17
Q16
Q21
Q9
Q13
Q18
D7
D10
D8
D9
D11
D27
D13
D12
D14
D15
JU1
JU2
JU3
JU4
JU5
JU6
T14
T7
T8



CHASSIS
TOP VIEW

PARTS LIST (KEY 1)

C1,C5 - .22uF Polyester Cap (224)

C2 - 22uF Electrolytic Cap

C3 - .1uF Mono Cap (104)

C4,C6,C8 - .01uF Mono Cap (103)

C7 - .15uF Polyester Cap (154)

D1,D2 - 1N4148 Silicon Diode

D3,D4 - 1N4007 Silicon Diode

J1 - 1/4" Stereo Phone Jack (KEY)

Q1 - BS170 Power Fet

Q2 - 2N4401 NPN Transistor

R1 - 56k Ohm 1/4w Res (GRN-BLU-ORG)

R2 - 500K PC Mount Trim Pot (504)

R3 - 220 Ohm 1/4W Res (RED-RED-BRN)

R4,R7 - 1M Ohm 1/4W Res (BRN-BLK-GRN)

R5 - 10M Ohm 1/4W Res (BRN-BLK-BLU)

R6,R10 - 470 Ohm 1/4W Res (YEL-VIO-BRN)

R8 - 47K Ohm 1/4W Res (YEL-VIO-ORG)

R9 - 4.7K Ohm 1/4W Res (YEL-VIO-~~ORG~~ RED)

R11 - 91K Ohm 1/4W Res (WHT-BRN-ORG)

R12 - 500K Ohm Audio Taper Panel Mount Pot (A500K)

S1 - SPDT Toggle Switch

PARTS LIST (KEY 1) cont

U1 - 5V Reg (78L05)

U2 - 8044ABM Curtis Keyer Chip (CMOS - USE CAUTION WHEN HANDLING)

1) 40-0103 - PC Board

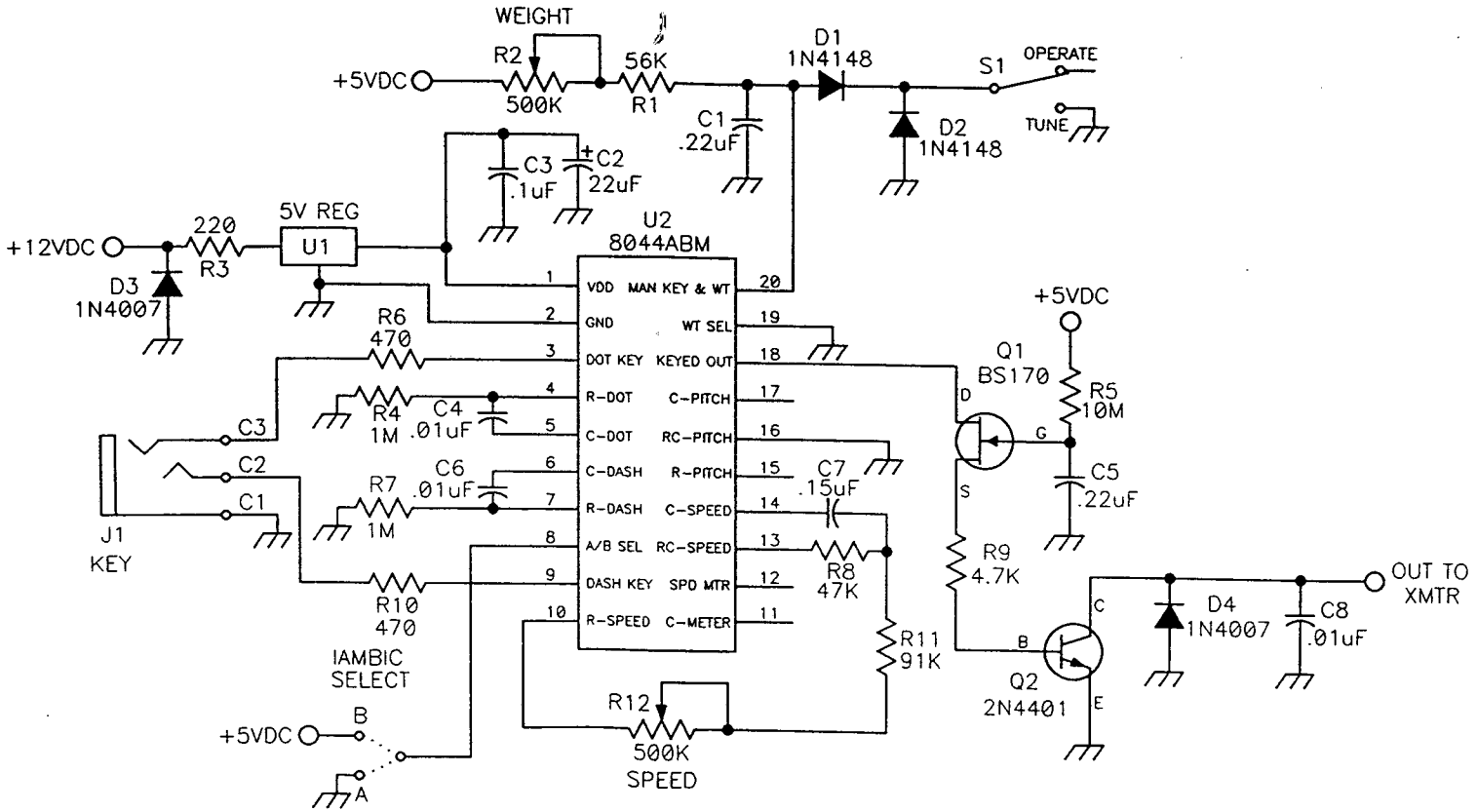
1) 20 pin dip IC socket

1) Small knob

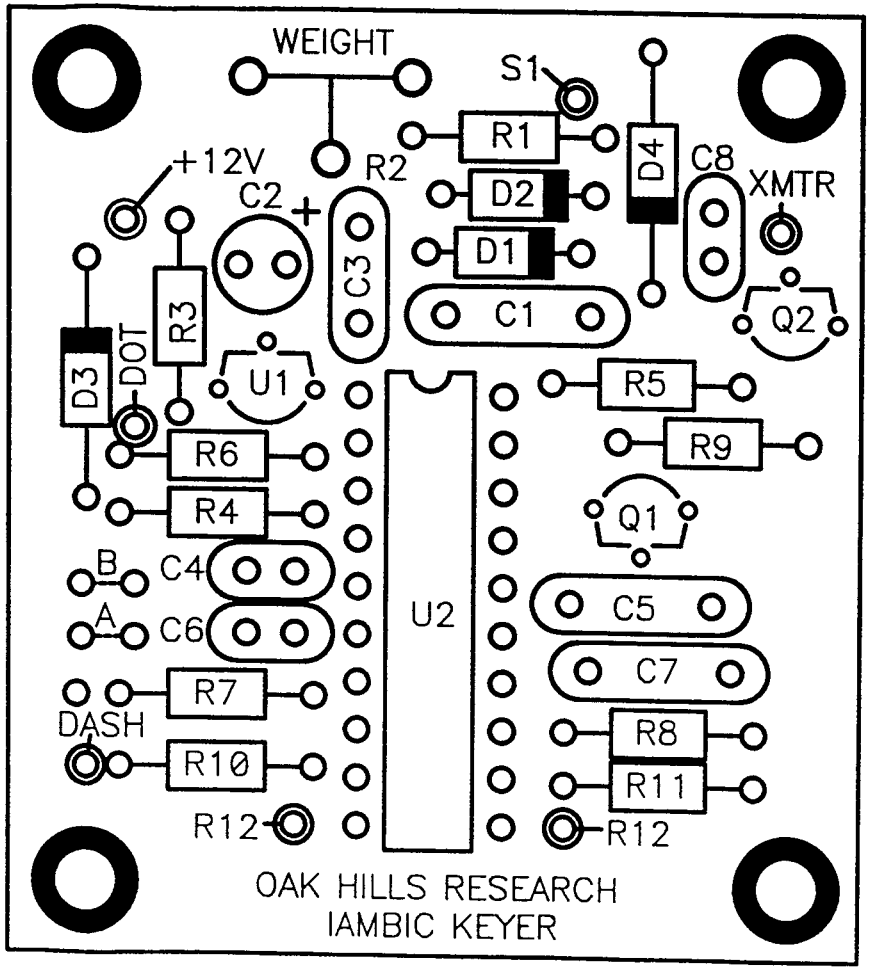
1) Hardware Pack

1) Wire Pack

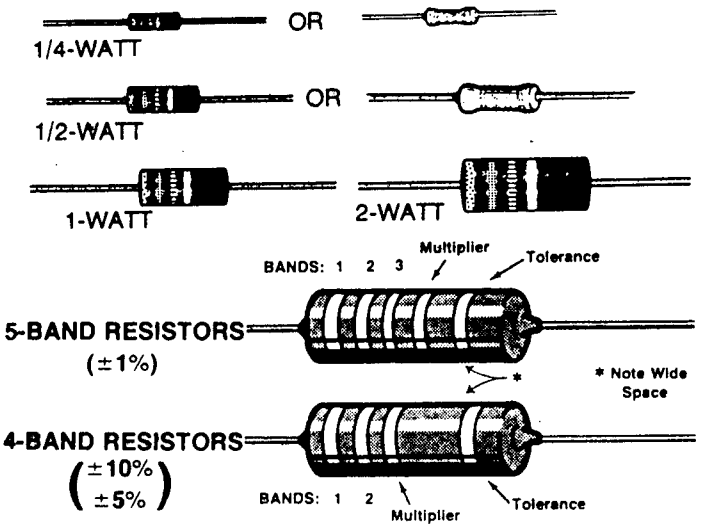
1) Instruction set



Title	OAK HILLS RESEARCH	
Size A	Number KEY 1 IAMBIC KEYER	Rev B
Date 8/92		Drawn by DW
Filename KEY.S01		Sheet 1 of 1

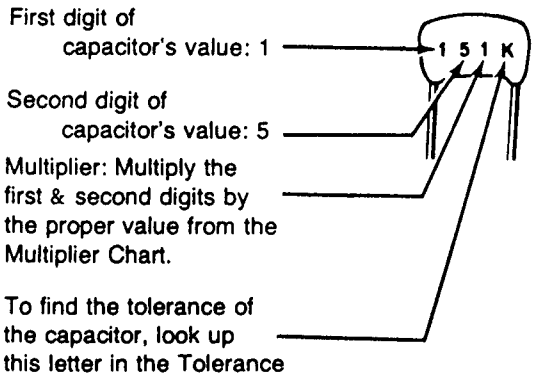

WEIGHT
S1
R1
D4
C8
XMTR
+12V
R2
C2
D2
D1
C3
R3
C1
Q2
D3
DOT
U1
R5
R6
R9
R4
Q1
B
C4
C5
A
C6
U2
C7
R7
R8
DASH
R10
R11
R12
R12
OAK HILLS RESEARCH
IAMBIC KEYER

RESISTORS & CHOKES



Band 1 1st Digit		Band 2 2nd Digit		Band 3 (if used) 3rd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	0	Black	1	Silver	±10%
Brown	1	Brown	1	Brown	1	Brown	10	Gold	± 5%
Red	2	Red	2	Red	2	Red	100	Brown	± 1%
Orange	3	Orange	3	Orange	3	Orange	1,000		
Yellow	4	Yellow	4	Yellow	4	Yellow	10,000		
Green	5	Green	5	Green	5	Green	100,000		
Blue	6	Blue	6	Blue	6	Blue	1,000,000		
Violet	7	Violet	7	Violet	7	Silver	0.01		
Gray	8	Gray	8	Gray	8	Gold	0.1		
White	9	White	9	White	9				

CAPACITORS


First digit of capacitor's value: 1
Second digit of capacitor's value: 5
Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.
To find the tolerance of the capacitor, look up this letter in the Tolerance columns.
1 5 1 K

EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 ×0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

1 YEAR LIMITED WARRANTY

PARTS - Replacements for defective parts will be supplied free of charge for a period of one year from the date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. If you do have a defective part, you may obtain a replacement by writing or calling us at (616) 796-0920. We will pay the shipping charges on these parts.

SERVICE LABOR - For a period of one year from the date of purchase, any malfunction caused by defective parts will be corrected at no charge to you. You must deliver the unit at your expense to Oak Hills Research. This warranty does not cover the corrections of assembly errors or any damage incurred during assembly of the unit.

TECHNICAL CONSULTATION - You will receive free consultation on any problem you may encounter in the assembly or use of our product. Just give us a call at (616) 796-0920, we will be glad to assist you.

NOT COVERED - The correction of assembly errors, adjustments, calibration, damage due to misuse, abuse or negligence are not covered by this warranty. Use of corrosive solder will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use or customer assembly.

This warranty covers only Oak Hills Research products and is not extended to other equipment or components that a customer uses in conjunction with our products.

EFFECTIVE WARRANTY DATE - Warranty begins on the date of first consumers purchase. Please supply a copy of your invoice when you request warranty service or parts.

SHIPPING UNITS - When shipping a unit back to us for repair, use adequate packing material. Damage due to inadequate packing cannot be repaired under this warranty.

OAK HILLS RESEARCH
20879 Madison Street
Big Rapids, MI 49307
(616) 796-0920